CLAIMS

Claim 1. An integrated dual-wavelength quantum well infrared photodetector (QWIP), comprising:

a common semiconductor substrate;

at least one standard quantum well in said substrate to yield a peak photo response at first wavelength; and

at least one sub-well in said substrate to yield a peak photo response at a second wavelength different from said first wavelength.

Claim 2. The photodetector as described in claim 1, wherein said first quantum well and said sub-well are separated by a barrier layer.

Claim 3. The photodetector as described in claim 2, wherein said photodetector is structured with a sequence of said barrier-said first quantum well-said sub-well-said barrier.

Claim 4. The photodetector as described in claim 3, wherein said sequence is periodic.

Claim 5. The photodetector as described in claim 4, wherein said sequence is vertically integrated.

Claim 6. The photodetector as described in claim 2, wherein said quantum well is of GaInAs, sub-well is of InAs, said barrier is of AlInAs, and said substrate is of InP.

Claim 7. The photodetector as described in claim 1, wherein said first wavelength and said second wavelength are merged to yield a broad-band photoresponse.

Claim 8. The photodetector as described in claim 1, wherein said first wavelength and said second wavelength are selected from a pair of the group consisting of near infrared (NIR), mid-wavelength infrared (MW), and long-wavelength infrared (LW).

Claim 9. The photodetector as described in claim 1, wherein said two dual wavelength structures are integrated vertically to form the group consisting of MW-MW, LW-LW, MW

Claim 10. The photodetector as described in claim 1, wherein said two dual wavelength structures are integrated by using selective epitaxy to form the group consisting of MW-MW, LW-LW

Claim 11. The photodetector as described in claim 1, wherein the typical thicknesses of the well are 20-100 Å and the sub-well channel are5-30 Å

Claim 12. The photodetector as described in claim 1, further comprising additional said quantum well and said sub-well to yield a multi-wavelength photodetector.

Claim 13. The photodetector as described in claim 1, further comprising a collector of the QWIP and an additional barrier of AlAs (AlSb, and AlAsSb) having large conduction band discontinuity to reduce dark current.

Claim 14. The photodetector as described in claim 1, wherein the wells/barriers are selected from the group III-V compound semiconductor family consisting of:
GaAs/AlGaAs, GaAs/GaInP, GaAs/AlAs, GaInAs/AlGaAs (AlAs, GaInP),
InAsP/AlInAs, InAsP/AlGaAsSb, GaInAs/ AlInAs (AlAsSb, AlInAsSb, AlGaAsSb, InP),
TlInP(TlGaInP, TlGaInAs)/AlInAs (AlAsSb, AlInAsSb, AlGaAsSb,InP,AlGaPSb), GaAsSb/InP
(AlInAs, AlAsSb, AlInAsSb, AlGaAsSb, AlGaPSb), InAs/AlGaAsSb(AlSb, AlAsSb, AlGaSb),
GaSb/AlGaAsSb(AlSb, AlAsSb, AlGaSb), InAsSb/AlGaInSb, InSb/AlInSb, GaN/AlGaN(AlN)[,]
and GaInN/AlGaN(AlN).

Claim 15. The photodetector as described in claim 1, wherein the conduction of the QWIPs is selected from the transport of electrons and holes.

Claim 16. The photodetector as described in claim 1, wherein the location of the sub-well in the quantum well is variable, the sub-well can be placed asymmetrically in the layer, and the sub-well can be placed symmetrically in the layer

Claim 17. The photodetector as described in claim 1, wherein each said sub-well layer selected from the group consisting of uniformly composition, pseudomorphic composition and self assembled quantum dots,

Claim 18. The photodetector as described in claim 1, wherein each said sub-well layer selected from the group consisting of InAs, InSb, TlP, TlAs, TlSb

Claim 19. The photodetector as described in claim 1, wherein adding an InSb- subwell in InAs/GaInSb based inter band Strain Layer Superlattice (SLS) detector structures to increase the responsivity and extend the wavelength to very long wavelength infrared (VLWIIR).

Claim 20. The photodetector as described in claim 1, wherein any combination of the quantum well/barrier kind pairs deposited on substrate selected from the group consisting of Si, Sapphire, GaN, SiC and AlN are selected from the group III-V compound semiconductor family consisting of:
GaN/AlGaN, GaInN/AlGaN, GaN/AlN, and GaInN/AlN.

Claim 21. The photodetector as described in claim 1, wherein well, barrier and sub-well are selected from the group of IV-IV semiconductor family consisting of Si, Ge, Sn and C

Claim 22. The photodetector as described in claim 1, wherein said the quantum well and the barrier are selected from the group of II-VI semiconductors family consisting of ZnSe, ZnS, CdTe, and CdS.

Claim 23. The photodetector as described in claim 1, wherein said the well, barrier and the sub-well are selected from the group of II-VI/III-V, IV-IV/III-V, IV-IV/II-VI semiconductors family consisting of Si/GaP, Si/ZnS, GaAs/ZnSe, and InSb/CdTe.

Claim 24.The photodetector as described in claim 1, wherein said substrate is selected from the group consisting of Si, GaAs, InP, GaN, AlN, SiC and.Sapphire

Claim 25. The photodetector as described in claim 1, wherein the device is grown via the group consisting of MBE/CBE/MEE/GSMBE/VPE/OMVPE/UHVCVD.